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MITI White Paper Highlights Economic Blocs

The European Community's approach to substantial further economic integration in 1992 and steps taken by the United States, Canada and Mexico toward a North American Free Trade Agreement have drawn top billing in the Ministry of International Trade and Industry's 1991 white paper on international trade. The report, released May 31, notes that Japan is the only large industrial nation not currently involved in either the EC 1992 process or the envisaged NAFTA. To analyze this situation MITI borrowed from a classic economic framework.

As explained in 1950 by the economist Jacob Viner, trading blocs create both problems and opportunities. A major problem is that outsiders, presumably Japan in this instance, could lose export markets and sources of imports as

Japanese Research And Development Spending Expands Again

An annual government survey of Japanese outlays for research and development clearly shows that FY 1989 was another record-setting year from almost every perspective. Increases in total and component spending underscore Japan's strong international competitive position and the nation's commitment to building the world's preeminent knowledge-intensive economy. The comparatively modest increase in spending for basic research and development, however, remains a glaring weakness.

For its latest report the Management and Coordination Agency surveyed 12,500 businesses (all with capital of at least Y5 million or $37,000 at Y135=$1.00), 2,200 universities and other academic institutions, and 1,500 private research organizations. Responses indicated that total Japanese R&D expenditures rose 11.2 percent to Y11.8 trillion ($87.4 billion) during the year ended March 31, 1990 (see Table 1). The percentage gain was the highest since FY 1985 and pushed up the ratio of total R&D spending to gross national product to just over 2.9 percent; the previous fiscal year's figure was just under that mark. Although the agency cautions that international comparisons are difficult because of exchange rate fluctuations, different accounting periods and other factors, it nevertheless claims that Japan probably spent more on R&D in FY 1989 than any other nation except the United States. Japan, however, earmarks only a small portion of its total for defense technology, making it possible that Japanese spending on civilian R&D approaches or even surpasses that by the United States.

Table 1: Japan's R&D Expenditures, FY 1984-FY 1989

(in billions of yen and percent)

Fiscal Year	Companies	Research Institutions	Universities	Total
1984	Y5,136.6	Y1,033.1	Y1,724.2	Y7,893.9
Change	12.6%	6.4%	4.5%	9.9%
Share	65.1%	13.1%	21.8%	100.0%
1985	5,939.9	1,160.6	1,789.8	8,890.3
Change	15.6%	12.3%	3.8%	12.6%
Share	66.8%	13.1%	20.1%	100.0%
1986	6,120.2	1,240.2	1,832.6	9,192.9
Change	3.0%	6.9%	2.4%	3.4%
Share	66.6%	13.5%	19.9%	100.0%
1987	6,494.3	1,384.5	1,957.9	9,836.6
Change	6.1%	11.6%	6.8%	7.0%
Share	66.0%	14.1%	19.9%	100.0%
1988	7,219.3	1,394.2	2,014.1	10,627.6
Change	11.2%	0.7%	2.9%	8.0%
Share	67.9%	13.1%	19.0%	100.0%
1989 (p)	8,200.0	1,500.0	2,100.0	11,800.0
Change	13.8%	7.1%	5.0%	11.2%
Share	69.5%	12.7%	17.8%	100.0%

Source: Management and Coordination Agency, Report on the Survey of Research and Development.

When analyzed by spending organization, the data show private companies continued to lead the way in FY 1989; their Y8.2 trillion ($60.7 billion) in expenditures was 13.8 percent more than the year before and came to 69.5 percent of total research outlays, compared with 67.9 percent in FY 1988. Academic laboratories' R&D budgets allowed 5 percent greater outlays, or Y2.1 trillion ($15.5 billion), and research institutions boosted spending by 7.1 percent to Y1.5 trillion ($11.1 billion). Both accounted for a smaller share of total spending than last year because these increases were significantly less than that recorded by private businesses; universities' share dropped from 19 percent to 17.8 percent and research institutions' share fell from 13.1 percent to 12.7 percent.

Not surprisingly, the private sector not only spent the largest amount on R&D but also provided the vast majority of funding in FY 1989. Businesses directed Y9.6 trillion ($71.1 billion) to their research laboratories, a 12.9 percent increase over FY 1988. This put their share of total R&D funds at 81.3 percent, the first gain since FY 1985. The government share of total R&D funding correspondingly declined from 19.9 percent in FY 1988 to 18.6 percent in FY 1989, even though it rose in absolute terms from Y2.1 trillion to Y2.2 trillion ($15.6 billion to $16.3 billion).

Spending broken down by purpose shows that commercialization of technology remains the top priority (see Table 2). Of the Y10.8 trillion ($80 billion) spent on hard sciences (excluding the social sciences and humanities), 63.2 percent was classified as "developmental," 23.9 percent as "applied" and 12.8 percent as "basic." These percentages mainly were unchanged from the previous year, although uneven spending gains were reported for each category (13.4 percent for development, 10.3 percent for applied and 8 percent for basic). The heavy commercial emphasis of Japanese R&D spending is highlighted by data

Table 2: Japan's Natural Science Research Expenditures by Purpose, FY 1984-FY 1989

(in billions of yen and percentage share)

Fiscal Year	Basic Research	Applied Research	Developmental Research
1984	Y959.9	Y1,780.8	Y4,340.2
	13.6%	25.1%	61.3%
1985	1,030.6	2,001.8	4,985.9
	12.9%	25.0%	62.2%
1986	1,102.8	2,030.8	5,185.0
	13.3%	24.4%	62.3%
1987	1,250.2	2,166.8	5,497.3
	14.0%	24.3%	61.7%
1988	1,288.0	2,346.6	6,041.0
	13.3%	24.3%	62.4%
1989 (p)	1,390.9	2,588.4	6,848.0
	12.8%	23.9%	63.2%

Source: Management and Coordination Agency, Report on the Survey of Research and Development.

showing that the average Japanese company devoted 2.7 percent of its total sales to R&D and that manufacturers had an even higher average of 3.3 percent.

Turning to trade in technology, the survey reported that for the first time since statistics have been collected, the value of Japan's technology exports nearly equalled the value of its imports of foreign know-how, as measured by the amount of licensing fees and royalties received and paid, respectively. Japanese firms spent Y329.9 billion ($2.4 billion) in FY 1989 to license foreign technology, a 6 percent increase over the previous period. Royalties received from abroad, however, rose by a whopping 34 percent to Y329.3 billion ($2.4 billion). The preliminary results released by the Management and Coordination Agency do not indicate the source of the increase.

Jon Choy

Trade Insurance Panel Eyes Debt-Reduction Plans

The debt-reduction plans being worked out by Tokyo and Western capitals for troubled international borrowers will require more budgetary help for the trade insurance program run by the Ministry of International Trade and Industry, the ministry's trade insurance advisory group warned in a June 10 report. In April Japan and other members of the so-called Paris Club of creditor nations agreed to a 50 percent reduction in Poland's government-to-government debt and private loans backed by official trade insurance; a similar arrangement was put together for Egypt the following month. Creditor governments have a choice of forgiving outstanding principal, reducing interest payments or some combination of these options.

Since the Ministry of Finance has philosophical problems with debt forgiveness, particularly for middle-income countries like Poland (see JEI Report No. 16B, April 26, 1991), MITI's trade insurance panel recommended that the interest rates on the commercial loans covered by the Polish and the Egyptian debt-relief arrangements be cut from market levels to concessional rates to help achieve the 50 percent reduction. The ministry's trade insurance program currently backs a total of about Y300 billion ($2.2 billion at Y135=$1.00) in commercial loans to Poland and Egypt. If the Japanese exporters and banks that extended these loans were to seek compensation for business losses caused by cut interest rates, the trade insurance fund eventually would have to pay out Y150 billion ($1.1 billion). That would be a major blow to MITI's plans to get the trade insurance fund, which had a deficit of Y369.8 billion ($2.7 billion) at the end of March, back into the black.

Since the worldwide debt crisis began deepening in 1982, MITI has tried to help struggling Third World borrowers by allowing them to extend the repayment schedules for commercial loans backed by trade insurance (see JEI Report No. 14A, April 12, 1991). It covered trade bills up to the insurance ceiling in exchange for borrowers agreeing to repay MITI what they owed originally plus additional interest that varied depending on the length of the extension. The ministry, in turn, borrowed from the government's Fiscal Investment and Loan Program, or capital budget, at commercial rates to bridge the temporary shortfall in the trade insurance account on the understanding that this money eventually would be repaid; obviously, the success of this plan depended on borrowers living up to the terms of their rescheduling agreements.

So far, MITI has covered more than Y1.7 trillion ($12.6 billion) worth of rescheduled payments in agreements with 32 countries. Of this total, almost half has been repaid to MITI in accordance with the arrangements worked out for extended repayment. MITI still expects to be able to balance the trade insurance fund over this decade. Therefore, it continues to provide trade insurance to back newly committed credits for selected countries with debt-rescheduling programs.

The presently envisioned means for implementing the debt-reduction arrangements for Poland and Egypt, however, would make it hard if not impossible for MITI to eliminate the deficit in the trade insurance account in the foreseeable future. There also are concerns that other heavily indebted countries, such as the Philippines and Peru, will press Japan for the same treatment given Poland and Egypt; Tokyo, however, considers these latter cases to be exceptional. Moreover, sub-Saharan countries and other countries with low national incomes, which had their outstanding debt reduced by one-third in 1988, now are suggesting that they should qualify for additional debt relief since they are at more of an economic disadvantage than Poland and Egypt.

Given the trade insurance account's problems and prospects, the MITI advisory panel urged the government to consider compensating the fund for losses attributable to the Polish and Egyptian debt-relief plans from money earmarked in the general account budget for official development assistance. Funding for foreign aid is one of the few budget categories that has increased at a rate far higher than the overall ceiling on discretionary spending in recent years, thereby allowing room for this proposal to be implemented. MITI plans to include the panel's recommendation in its FY 1992 budget request, which will be compiled in August. If the ministry gets its way, it will start writing trade insurance on new commercial loans to Poland and Egypt; new lending to these countries has been suspended since the spring.

Tadashi Saito

Nakayama Visit Hints At Improved Japan-Israel Ties

Foreign Minister Taro Nakayama's May 30-June 1 visit to Jerusalem contained hints of a possible expansion of political and commercial ties between Japan and Israel. Corporate Japan's observance of the Arab economic boycott of Israel seems to be easing slightly. There also are indications that Tokyo will be increasingly attentive to relations with Israel. Steady pressure from Washington in recent years as well as the impact of the Persian Gulf War appear to be factors in the gradually changing Japanese stance.

Mr. Nakayama, who traveled to Israel on a Middle East tour that also included Iran and Egypt, told leaders in Jerusalem that Japan is interested in playing a more active role in the region. During a meeting with his Israeli counterpart David Levy, the Japanese foreign minister expressed Tokyo's support for a regional peace conference proposed by the United States and cited United Nations resolutions calling for an Israeli withdrawal from land annexed in the 1967 Arab-Israeli War. Mr. Nakayama asked that Israel make a "reasonable and flexible" response to the U.S. proposal, but Mr. Levy countered that such a conference would be contingent on Syria's stance. Mr. Nakayama further promoted U.S. goals for peace talks by asking for better treatment of Palestinians

living in the West Bank and the Gaza Strip plus an end to construction of settlements for Jewish residents in these occupied lands. Mr. Levy responded, however, that Israel has agreed with Washington on a two-phase plan to resolve the Palestinian issue and would not make further concessions.

Addressing Japan's stated interest in playing a larger role in the region, Prime Minister Yitzhak Shamir proposed that Tokyo help fund the resettlement of Palestinian refugees in occupied territories. Prior to a tour of a West Bank refugee camp and a meeting with Palestinian leaders, Mr. Nakayama, in fact, promised that Japan would extend greater economic and political assistance for the Palestinians through international organizations. That pledge came in a speech at the opening of a Japan-funded community center for Palestinians.

The Arab boycott issue also was raised during the foreign ministers' meeting. In response to Mr. Levy's request for assistance in breaking the decades-old ban -- under which certain Arab nations reportedly refuse to do business with companies that deal with Israel -- Mr. Nakayama characterized the boycott as undesirable and an impediment to international trade. While the United States, Canada and some Western European nations prohibit companies from adhering to the boycott, Japan officially takes a hands-off approach. Tokyo has said that observance of the boycott is a matter for the private sector to decide based on commercial considerations. In general, Japanese companies have been careful to keep open opportunities for trading with Arab countries; as a result, Japan has been characterized as being more stringent about the boycott than any other non-Arab country. The Israeli government has noted that it receives frequent complaints about Japanese companies that will not sell to Israeli buyers. An April report by the New York-based World Jewish Congress described Japan as "the country whose indiscriminate, government-encouraged compliance with the Arab boycott surpasses that of any other industrialized state."

Such criticism is not new, but soon after the report was released several Japanese companies named as refusing to deal directly with Israel announced plans to change their trade practices. Toyota Motor Corp. said it would begin exporting 5,000 cars a year to Israel this fall; Nissan Motor Co., Ltd. and Mazda Motor Corp. later announced similar plans. The three motor vehicle manufacturers said commercial considerations drove their decisions. Yet analysts suggest that Japanese firms may be reassessing their stance toward Israel due to perceived political shifts in the region following the Persian Gulf War as well as concern that their continued reluctance to deal with Israel may lead to a boycott of Japanese products in the United States. The head of the World Jewish Congress greeted the announcement that Nissan would start exports to Israel as an "important signal that Japan's policy toward Israel is changing," adding that it would help Japan's image in the United States.

Japanese firms with links to Israel also were criticized for the speed with which they cut those ties during the Persian Gulf War; commercial and financial exchanges between the two countries plummeted, and even postal service briefly was blocked during the war. Bilateral trade returned to previous levels soon after the ceasefire, however. Although slight compared to trade between Japan and the oil-rich gulf nations, Japan-Israel dealings have grown consistently in recent years (see Table). Such firms as Mitsubishi Motors Corp., Honda Motor Co., Ltd. and Fuji Heavy Industries, Ltd. long have traded with Israel. Tokyo's reported plans to add a Ministry of International Trade and Industry representative to its embassy in Israel may foreshadow stronger trade ties.

Japan's Trade with Israel, 1985-90

(in millions of dollars; exports f.o.b., imports c.i.f.)

	1985	1986	1987	1988	1989	1990
Exports	$170.4	$274.9	$346.0	$420.4	$317.5	$509.0
Imports	214.9	322.4	481.2	684.5	757.9	879.4
Balance	-44.5	-47.5	-135.1	-264.0	-440.3	-370.4

Source: Japan Tariff Association

Analysts and business leaders disagree over how readily most Japanese firms will redirect their Middle East trade efforts to include Israel. For its part, Washington has sent clear signals that it would like to see improved Japan-Israel ties. In April President Bush told Prime Minister Toshiki Kaifu that the conclusion of the Persian Gulf War "might be an opportunity for Japan to have closer relations with Israel." Vice President Dan Quayle underscored this suggestion during his May visit to Japan. Washington has prompted Tokyo to strengthen relations with Israel through economic assistance as well as increased business ties. During his recent visit Mr. Nakayama said that, at Israel's request, Japan is prepared to extend unprecedented help through letters of credit from the Export-Import Bank, one of the most common channels for Japanese aid to more developed countries.

Margo Grimm

Tokyo Opposes Moscow's Full Participation At G-7 Meeting

The Japanese government recently objected to the Soviet Union's participation in the upcoming London meeting of the leaders of the seven major industrial democracies on the grounds that "it would not be productive." Some summiteers had sought to include Soviet President Mikhail Gorbachev in the discussions. In their view his inclusion not only would recognize the advances the Soviet Union has made politically but would allow Mr. Gorbachev an opportunity to plead his case for more Western economic assistance to bolster his troubled domestic reform program. Tokyo, however, has insisted that Moscow implement economic reforms before receiving major outside financial assistance. Due to the Japanese government's objections and the concerns of other summit participants, including President Bush, Mr. Gorbachev instead will meet with the leaders of the United States, Great Britain, France, Italy, Germany, Canada and Japan for two days as a guest immediately following the formal discussions. "It is not going to be the G-8. It will still be the G-7," a government official of this year's host, Great Britain, was quoted as saying.

In what may be a repeat of last summer's Group of Seven meeting in Houston, Texas, Japan appears likely to take a hard line on the question of aid to the Soviet Union (see JEI Report No. 28B, July 20, 1990). Tokyo's resistance is rooted in its policy of delaying the increased economic assistance sought by Moscow until a long-standing dispute is resolved between the two countries concerning the Soviet Union's occupation of four islands northeast of Hokkaido --

NOTE

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JEI REPORT

A Two-Part Report: A and B

NO. 23A June 21, 1991

JAPAN'S ENERGY POLICY IN THE '90S

Summary

After being pushed from the top of the national agenda by several years of robust economic growth and moderate international crude oil prices, energy policy edged back to center stage in the aftermath of Iraq's invasion of Kuwait. Armed with emergency measures previously employed during the twin oil shocks of the 1970s, policymakers were able to cushion the impact of the Persian Gulf situation on the economy. Notwithstanding this achievement, Tokyo is refocusing attention on energy conservation and development of alternative energy sources, especially nuclear power. In contrast to the 1970s and 1980s, however, the domestic political and social environment is less friendly to conservation as well as atomic energy, although Tokyo is making more of an effort to influence international energy issues.

Current Energy Picture

Japan's continuing economic expansion kept energy consumption on an upward path in FY 1990, which ended March 31, 1991, according to Ministry of International Trade and Industry figures (see Table 1). Of key importance was the growth in energy consumed by the household and the transportation sectors, which once again outpaced the growth of industrial energy use. Seeking a better standard of living, Japanese consumers have been buying bigger and more appliances, as well as driving larger cars and flying overseas. This trend not only reinforces the government's claim that domestic demand has become a central pillar of economic growth but adds as well to baseline demand for energy. Increased energy demand, in fact, has pushed energy consumption ahead at a faster rate than overall economic growth. If government projections are correct, the Japanese economy suffered a second straight year of reduced energy efficiency in FY 1990, measured by dividing total economic output by total energy consumption (Table 2).

As for the supply of energy (Table 3), oil's share of the total supply dropped in FY 1990 to 54.8 percent from the year earlier figure of 57.5 percent, itself up 0.3 percentage point. The FY 1990 decline in oil's dominance probably was due to conservation measures taken after Japan and Western allied nations embargoed oil exports from Iraq and Iraqi-occupied Kuwait in August 1990. In absolute terms, however, crude oil consumption continued its steady

Table 1: Japan's Energy Consumption by Sector

(in millions of kiloliters of crude oil equivalent; percent change in parentheses)

Sector	FY 1987	FY 1988	FY 1989	FY 1990*
Industry	163 (4.9%)	173 (5.9%)	180 (4.0%)	188 (4.4%)
Households	76 (5.2%)	80 (5.3%)	85 (6.3%)	90 (5.9%)
Transportation	69 (4.1%)	72 (4.3%)	76 (5.5%)	81 (6.6%)
Total	308 (4.8%)	325 (5.5%)	341 (5.1%)	359 (5.3%)

*Partially estimated.

Source: Ministry of International Trade and Industry

Table 2: Japan's GNP and Energy Consumption

	FY 1987	FY 1988	FY 1989	FY 1990*
Gross National Product**	Y349,769.8	Y370,311.5	Y388,200.2	Y408,386.6
Change	4.9%	5.9%	4.8%	5.2%
Energy Consumption (kl)***	308	325	341	359
Change	4.8%	5.5%	5.1%	5.3%
GNP per Kiloliter****	Y1,135,616.2	Y1,139,420.0	Y1,138,417.0	Y1,137,567.1

*Projected.
**GNP in billions of yen at 1985 prices.
***Energy consumption in millions of kiloliters of crude oil equivalent.
****GNP per kiloliter of crude oil equivalent in yen.

Source: Ministry of International Trade and Industry

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Table 3: Japan's Energy Supply by Source

(in millions of units)

	FY 1989			FY 1990*			
	Actual	Crude Oil Equivalent	Share	Actual	Crude Oil Equivalent	Share	Percent Change
Oil (kl)	291.8	291.8	57.5%	292.5	292.5	54.8%	0.2%
Coal (mt)	121.3	92.4	18.2	139.2	106.1	19.9	14.8
Nuclear (kw)	79.2	49.7	9.8	81.6	51.2	9.6	3.0
Natural Gas (kl)	46.2	46.2	9.1	54.4	54.4	10.2	17.7
Hydroelectric (kw)	33.1	20.8	4.1	34.9	21.9	4.1	5.4
Alternatives (kl)	6.6	6.6	1.3	7.5	7.5	1.4	13.6
Total		507.5	100.0		533.4	100.0	5.1

*Partially estimated.

Source: Ministry of International Trade and Industry

climb, indicating how entrenched this source of energy is in the Japanese economy. Nevertheless, fears that the Persian Gulf crisis might cause oil shortages appeared to be behind the greater use of coal (up 14.8 percent) and natural gas (up 17.7 percent); the former went mainly for electricity generation and the latter for heating. After years of gradual expansion, nuclear power's share of the total energy supply slipped back to the level of fiscal 1988, despite a slight increase in the amount of power generated. Alternative energy sources provided a bright spot in a diversified supply picture by gaining some increase in share but showing strong growth in output.

The jump in imports of crude oil in 1990 (Table 4) highlights the efforts of domestic oil companies to negotiate the impact of the embargo on Iraqi

Table 4: Japan's Crude Oil Imports, Production and Inventories

(in 1,000 kiloliters)

	Production	Imports	Throughput	Rate of Operation	Ending Inventories
1980	505	256,833	232,452	67.3%	37,841
1981	456	230,239	210,072	60.9	35,978
1982	467	214,685	194,844	56.5	32,737
1983	492	207,794	187,780	56.9	29,550
1984	476	214,602	194,111	67.1	26,058
1985	625	198,330	179,805	62.3	25,483
1986	736	194,515	172,071	60.6	27,888
1987	707	185,380	167,389	60.7	26,953
1988	689	193,851	172,392	64.4	22,838
1989	641	209,691	182,703	69.2	23,364
1990	632	228,760	199,431	75.5	23,183

Source: Petroleum Association of Japan

and Kuwaiti oil. The 9.1 percent boost in crude imports put the annual import figure at its highest point in nearly a decade. Besides securing alternative sources of crude, domestic producers were able to lift output by turning to private and government strategic reserves to meet rising oil demand. The increased refinery throughput and rate of operation are clear responses to the Persian Gulf crisis.

Imports of petroleum products and nonoil energy sources showed mixed results in FY 1990 (Tables 5 and 6), with coal, heavy fuel oil, liquefied petroleum gas and liquefied natural gas imports rising and gasoline, kerosene and naphtha imports declining. Kuwait, Saudi Arabia and other Middle Eastern countries have been moving downstream into refined products. Partially in response to this but mainly because of pressure from the United States and Europe, Tokyo liberalized imports of refined products in 1986. It also has been trying to get domestic refiners to cut capacity. The plunge in imports of gasoline (35.5 percent), kerosene (33.4 percent) and naphtha (8.9 percent) was a direct result of the Persian Gulf conflict's impact on Middle Eastern refineries.

Table 5: Japan's Imports of Gasoline and Kerosene

(in 1,000 kiloliters and percent change over previous year)

	Gasoline		Kerosene	
	Amount	Change	Amount	Change
1985	0	--	0	--
1986	3,293	--	2,648	--
1987	4,190	27.2%	6,012	127.0%
1988	3,902	-6.9	7,472	24.3
1989	3,934	0.8	8,170	9.3
1990	2,537	-35.5	5,434	-33.5

Source: Petroleum Association of Japan

The upswing in imports of heavy fuel oil in 1990 conveyed another disappointment for energy planners. Tokyo, which has been urging industry to shift to cleaner, more efficient fuels for some time, was shocked by the jump in imports of heavy fuel oil in 1987 and again in 1990. Energy planners are hoping that 1990's record imports are a fluke caused by the gulf conflict and an unusually hot summer that forced utilities to reopen oil-fired generators. These same two factors probably boosted imports of coal as well. The domestic petrochemical industry was concerned over the gulf conflict's effect on supplies of naphtha, a basic feedstock, but domestic refiners were able to increase their output or find alternative sources.

Not at all surprising was the jump in the average cost of a barrel of oil between 1989 and 1990. After bottoming out in 1988 at $15.60 a barrel or Y12,550 per 1,000 kiloliters, oil prices moved up moderately in 1989 and then sharply in 1990. In an unfortunate confluence for Japanese importers, the yen depreciated against the dollar in 1989 and 1990, exacerbating the reflected yen cost of products that are denominated in dollars on global markets, such as crude oil (Table 7). The dollar cost of a barrel of crude rose 33.4 percent in

Table 6: Japan's Noncrude Oil Energy Imports

(in thousands of units)

	Coal (mt)	Naphtha (kl)	Heavy Fuel Oil (kl)	LPG (mt)	LNG (mt)
1980	68,570	7,363	7,431	9,725	16,324
1981	77,959	7,241	7,404	10,097	16,833
1982	78,535	8,998	6,893	11,861	17,480
1983	75,124	13,096	7,285	10,860	18,748
1984	87,227	13,414	7,342	11,320	25,738
1985	93,448	14,896	7,493	11,540	27,556
1986	90,392	17,294	6,924	11,942	28,261
1987	90,915	20,043	8,010	12,612	29,167
1988	101,243	22,634	7,993	12,690	30,765
1989	101,509	23,676	8,056	14,039	33,202
1990	103,550	21,573	8,951	14,723	35,627

Source: Ministry of International Trade and Industry

Table 7: Price (c.i.f.) of Imported Crude Oil

	Volume (1,000 kl)	Value ($ millions)	Dollars per Bbl	Yen per Kiloliter	Exchange Rate*
1980	254,428	$52,749	$32.97	Y47,197	Y236.14
1981	227,444	53,343	37.29	51,387	219.10
1982	212,235	46,266	34.66	53,906	247.28
1983	207,004	40,063	30.77	45,923	237.28
1984	208,908	39,379	29.36	43,713	236.66
1985	195,945	34,600	28.07	42,374	239.97
1986	188,838	19,502	16.42	18,189	176.12
1987	184,713	20,593	17.79	16,328	145.89
1988	192,166	18,852	15.60	12,550	127.93
1989	204,914	21,539	16.71	14,453	137.47
1990	225,251	31,584	22.29	19,842	141.51

*Yen per dollar; crude oil contract rate.

Source: Ministry of Finance

1990, while the price of a kiloliter in yen rose 37.3 percent. Prices for refined products (Tables 8 and 9) clearly showed the shock waves from Iraq's invasion of Kuwait, at both the wholesale and the retail levels. Wholesale and consumer prices generally moved in step with each other, although the latter showed a wider range of swings than the former. The change in the wholesale price of gasoline, for example, peaked at 11.9 percent (November's price compared to that in August when Iraq took over Kuwait), while gas prices at the consumer level rose 13.3 percent over the same period. Kerosene showed even broader fluctuations, jumping 60.1 percent at its peak retail price in October

Table 8: Wholesale Petroleum Product Price Indices

	Gasoline	Naphtha	Jet Fuel	Kerosene	LPG	Fuel Oil C
			(1980=100)			
1980	100.0	100.0	100.0	100.0	100.0	100.0
1981	106.2	99.7	108.6	114.4	112.8	118.0
1982	114.1	101.4	121.7	131.2	129.6	124.1
1983	111.1	91.9	123.3	125.0	123.1	116.3
1984	108.6	81.1	122.0	121.2	119.4	101.8
1985	106.3	79.2	122.7	115.3	113.4	106.9
1986	94.2	45.6	98.5	86.1	83.6	72.8
			(1985=100)			
1985	100.0	100.0	100.0	100.0	100.0	100.0
1986	88.6	57.6	80.3	74.7	73.7	68.0
1987	82.0	41.1	66.4	62.3	61.2	38.5
1988	79.4	36.3	63.5	54.4	53.0	40.7
1989	83.3	38.2	65.6	60.9	59.3	39.4
1990	87.7	45.7	75.5	75.5	73.6	47.7
1990: I	85.1	41.1	71.4	67.8	66.1	46.7
II	85.1	45.4	72.6	69.2	67.4	47.7
III	85.6	47.5	71.8	72.9	71.0	47.7
IV	94.2	48.6	86.3	92.1	89.9	48.6
1991: I	88.1	65.4	80.2	76.8	74.8	60.8

Source: Bank of Japan

Table 9: Consumer Prices for Petroleum Products

	National Price Index (1985=100)			Tokyo Retail Prices		
	Gasoline	Kerosene	Propane	Gasoline (1 liter)	Kerosene (18 liters)	Propane (cu. m.)
1980	85.6	107.4	94.9	Y155	Y1,543	Y4,881
1981	108.3	113.6	98.4	157	1,628	5,079
1982	118.1	125.9	98.6	172	1,791	5,104
1983	109.0	118.6	99.2	156	1,718	5,134
1984	103.4	109.1	99.7	150	1,613	5,131
1985	100.0	100.0	100.0	146	1,494	5,104
1986	88.0	82.6	97.0	128	1,246	4,974
1987	85.3	61.5	91.5	126	918	4,747
1988	81.6	53.5	89.0	122	842	4,590
1989	84.1	52.5	89.5	122	838	4,584
1990	88.5	66.1	94.1	142	1,284	5,316
1990: I	85.4	59.1	90.4	127	910	4,596
II	89.5	60.6	91.8	128	922	4,664
III	86.1	61.3	94.2	128	925	4,722
IV	96.3	89.5	99.8	141	1,237	5,134
1991: I	94.5*	81.0*	103.5*	136	1,205	1,775

*January-February 1991 only.

Source: Management and Coordination Agency

but up only 36.6 percent at its highest wholesale price for the period. This discrepancy occurred despite close monitoring of energy prices by the Ministry of International Trade and Industry as well as other government agencies and warnings against price gouging (see JEI Report No. 43B, November 9, 1990).

With the economy continuing its second-longest postwar expansion in 1990 electricity output and consumption (Tables 10 and 11) grew as a natural consequence. Thermal sources, mainly oil- and coal-fired generators, maintained their share of total generated output at over 61 percent in 1990 for the second consecutive year. Nuclear power got back on track last year, generating a record amount of electricity despite the unexpected shutdown of two reactors (more

Table 10: Output of Electric Utilities in Japan

(in billions of kilowatt-hours)

	Total	Thermal	Nuclear	Hydro
1980	514.05	346.90	82.01	85.15
1981	523.14	352.18	87.23	83.74
1982	522.48	343.30	101.84	77.34
1983	555.49	360.98	113.12	81.39
1984	582.21	378.32	133.23	70.65
1985	603.93	363.75	158.98	81.19
1986	601.51	354.65	167.31	79.55
1987	640.16	378.99	186.61	74.57
1988	666.77	399.46	177.62	88.62
1989	704.68	431.16	181.86	90.54
1990	745.13	460.62	194.57	88.59

Source: Ministry of International Trade and Industry

Table 11: Japan's Electricity Consumption

(in billions of kilowatt-hours)

			Power				
				Manufacturing			Rail-
	Total	Light	Total	Total	Chemicals	Steel	roads
1980	464.25	105.27	353.98	190.77	26.79	61.80	12.71
1981	470.56	110.30	360.27	184.29	26.28	58.49	12.86
1982	471.44	112.79	358.65	177.95	29.22	53.69	13.06
1983	499.78	122.22	377.57	182.62	27.55	55.47	13.33
1984	524.53	127.51	397.02	191.97	28.76	57.04	13.13
1985	541.39	133.30	408.09	193.75	28.23	55.88	13.44
1986	537.74	136.52	401.22	182.05	25.61	50.01	13.62
1987	570.64	146.11	424.53	189.41	26.55	51.63	14.15
1988	597.41	153.08	444.33	203.83	26.18	54.69	14.77
1989	632.31	163.42	468.89	217.27	27.74	56.87	18.10
1990	667.44	174.15	493.28	206.62	28.24	57.87	16.18

Source: Ministry of International Trade and Industry

on this subject below). The unsteady performance of hydroelectric power reflects its dependence on the vagaries of precipitation. (Note that these figures do not agree with those in Table 3, which are on a fiscal year basis.)

On the consumption side the divergence between industrial and household demand was stark. Because electricity use by manufacturers fell about 10.7 billion kilowatt-hours in 1990, demand by other users for power and light must have increased by 45.8 billion kilowatt-hours in order to yield a net growth of 35.1 billion kilowatt-hours for the year. Coming on top of a 34.9 billion kilowatt-hour increase the year before, 1990's growth in demand set off alarms at MITI and the utilities as peak capacity generation margins narrowed to uncomfortably thin levels (see JEI Report No. 18B, May 10, 1991). The disappearance of a comfortable capacity margin has spurred utilities to boost their capital spending plans and added urgency to the factors complicating the ongoing debate over nuclear power.

Japan's consumption of nonoil energy (Table 12) showed a checkerboard pattern in 1990. The appetites of the steel industry and the manufacturing

Table 12: Japan's Consumption of Imported Noncrude Oil Energy

(in thousands of units)

	Coal (mt)			Heavy Fuel Oil (kl)			
	Coke	Steel	Power	Agriculture	Manufacturing	Shipping	Power
1980	4,309	64,440	10,208	1,410	43,747	6,154	38,360
1981	5,197	64,650	13,972	1,044	35,690	4,730	34,508
1982	4,330	62,470	15,299	906	30,209	4,365	30,983
1983	4,551	57,368	18,063	1,051	27,769	4,112	29,476
1984	5,014	65,963	20,306	1,309	26,655	4,909	29,220
1985	5,821	66,344	23,988	1,303	24,853	4,709	22,271
1986	5,528	62,982	23,588	1,498	24,121	4,663	19,952
1987	4,652	59,221	14,237	1,708	24,787	4,784	18,411
1988	5,025	66,389	14,961	2,038	26,949	5,183	19,408
1989	4,856	64,258	15,827	2,058	27,430	5,570	21,482
1990	5,012	62,795	17,208	2,394	25,470	3,644	24,413

	LPG (mt)			LNG (mt)	
	Chemicals	Power	Motor Vehicles	Residential	Power
1980	4,485	3,327	1,548	3,180	12,554
1981	4,465	2,707	1,241	3,411	12,857
1982	4,465	2,707	1,241	3,411	12,857
1983	4,047	3,082	1,822	4,195	14,039
1984	5,029	3,381	1,843	5,561	19,606
1985	5,176	3,321	1,722	5,589	21,396
1986	5,292	3,417	1,728	6,228	21,458
1987	5,492	3,680	1,543	6,518	22,080
1988	1,640	4,374	1,460	6,804	23,393
1989	1,947	4,729	1,445	7,855	24,736
1990	2,359	4,390	1,876	8,242	26,772

Source: Ministry of International Trade and Industry

sector for coal and heavy fuel oil, respectively, were noticeably smaller than in the previous two years. As mentioned above, however, imports of these two fuels for power generation showed strong gains. The chemicals industry used more imported liquefied petroleum gas as a substitute for other feedstocks. Interestingly, Japan's efforts to promote liquefied petroleum gas as an automotive fuel received an apparent boost from the Persian Gulf crisis, as consumption in 1990 jumped sharply to a new record, reversing the gradual decline begun in 1985.

Despite the unavailability of full-year data for 1990, trends in energy consumption by households (Table 13) are evident. The data show that consumption of electricity for the first 11 months of 1990 almost had reached the level recorded for all of 1989. As for 1990 consumption of propane, kerosene and liquefied petroleum gas, the preliminary figures point to equal or slightly lower full-year levels as compared with the previous year. Heavier use of "cleaner" energy sources -- electricity, propane and LPG -- contrasted with the sharp reductions in consumption of coal, briquettes and other "dirty" fuels. Notwithstanding this trend, the increased rate of household energy use caught MITI planners off guard and upset long-term energy projections.

Table 13: Household Energy Consumption in Japan

	Electricity (mil kwh)	Propane (bil kcal)	Kerosene (1,000 kl)	LPG (1,000 mt)	Other Solids (1,000 mt)	Coal (1,000 mt)
1980	103,199	56,008	16,725	4,984	1,212.3	578.5
1981	108,979	58,178	16,730	5,336	970.0	472.5
1982	110,051	58,200	15,275	5,295	1,173.0	512.8
1983	117,905	60,748	15,928	5,460	1,010.3	509.2
1984	125,588	66,065	17,130	5,696	1,413.2	469.1
1985	129,682	65,706	16,060	5,611	1,479.3	371.9
1986	134,078	70,127	16,992	5,835	1,222.5	304.0
1987	141,531	69,799	16,556	6,114	969.9	228.3
1988	151,067	75,559	18,503	6,848	1,194.9	184.7
1989	159,819	76,338	17,296	6,907	1,107.5	140.3
1990	159,801*	76,448	12,218**	5,467**	806.5*	92.5*

*January-November only.
**January-October only.

Source: Ministry of International Trade and Industry

Best Laid Plans: Boon or Bane?

The degree to which energy demand has outdistanced the expectations of MITI energy analysts can be seen in the ministry's most recent long-term energy outlooks (Table 14). The October 1987 projection envisioned a 33.9 percent rise in total energy demand over the next two decades. Three years later the projected increase in total demand was raised to 38.2 percent. To the surprise of MITI planners total energy use in FY 1988 nearly had reached the level projected for FY 1995 in October 1987. In the midst of the Persian Gulf crisis the

Table 14: Long-Term Energy Outlook

(in millions of units as specified and percent share)

October 1987

	FY 1986		FY 1995		FY 2000		FY 2005	
	Units	Share	Units	Share	Units	Share	Units	Share
Coal (mt)	103.9	18.3%	121.0	18.3%	136.0	18.7%	150.0	19.0%
Nuclear (kw)	25.8	9.5	41.5	13.4	53.5	15.9	65.0	18.0
Natural Gas (kl)	42.8	9.9	55.0	11.1	58.0	10.8	60.0	10.0
LNG (kl)	28.8	6.7	36.0	7.3	38.0	7.1	---	---
Hydroelectric (kw)	35.8	4.2	42.5	4.5	45.5	4.4	48.5	4.0
Geothermal* (kl)	0.4	0.1	2.0	0.4	4.4	0.8	6.0	1.0
Alternatives* (kl)	5.5	1.3	12.5	2.5	24.5	4.5	52.0	9.0
Oil (kl)	246.0	56.8	245.0	49.7	242.0	45.0	240.0	42.0
Domestic (kl)	0.7	0.2	1.3	0.3	1.9	0.4	---	---
LPG (mt)	16.2	---	18.0	---	19.0	---	---	---
Total* (kl)	433.0	100.0	490.0	100.00	540.0	100.0	580.0	100.0

June 1990

	FY 1988		FY 2000		FY 2010	
	Units	Share	Units	Share	Units	Share
Coal (mt)	114.6	18.1%	142.0	17.4%	142.0	15.5%
Nuclear (kw)	179.0	9.0	330.0	13.2	474.0	16.7
Natural Gas (kl)	46.1	9.6	65.0	10.9	80.0	12.0
Hydroelectric (kw)	86.0	4.6	91.0	3.7	105.0	3.7
Geothermal* (kl)	0.4	0.1	1.8	0.3	6.0	0.9
Alternatives* (kl)	6.2	1.3	17.4	2.9	34.6	5.2
Oil (kl)	276.0	57.3	308.0	51.6	306.0	46.0
LPG (mt)	17.4	---	22.0	---	23.0	---
Total* (kl)	482.0	100.0	597.0	100.0	666.0	100.0

October 1991

	FY 1989		FY 2000		FY 2010	
	Units	Share	Units	Share	Units	Share
Coal (mt)	113.6	17.3%	142.0	17.5%	142.0	15.7%
Nuclear (kw)	183.0	8.9	330.0	13.3	474.0	16.9
Natural Gas (kl)	49.9	10.0	65.0	10.9	80.0	12.2
Hydroelectric (kw)	88.0	4.6	91.0	3.7	105.0	3.7
Geothermal* (kl)	0.4	0.1	1.8	0.3	6.0	0.9
Alternatives* (kl)	6.4	1.3	17.4	3.0	34.6	5.3
Oil (kl)	289.0	57.9	305.0	51.3	298.0	45.3
LPG (mt)	17.4	---	22.0	---	23.0	---
Total* (kl)	499.0	100.0	594.0	100.0	657.0	100.0

*Crude oil equivalent.

Source: Ministry of International Trade and Industry

ministry issued another long-range forecast, which modestly scaled back expected demand for oil in the year 2010. The ministry apparently hoped that the Persian Gulf crisis would lead to renewed conservation efforts and spur development of alternative energy sources, particularly nuclear power. Critics immediately charged that the latest projections were unrealistic.

MITI analysts are finding that their crystal balls were clouded in relation to other forecasts as well. A five-year outlook for petroleum product demand (Table 15) predicted an average annual increase of only 2.3 percent between FY 1988 and FY 1994. Between FY 1988 and FY 1990, however, demand ran almost half-again above MITI's estimate. The ministry probably will issue new long-term energy and petroleum product demand outlooks this summer.

Table 15: Five-Year Outlook for Japanese Demand for Petroleum Products

(in thousands of kiloliters and percent change)

Product	FY 1988 (estimated)	FY 1989 (projected)	Change	FY 1993 (projected)	1988-94 Average Annual Change
Gasoline	39,622	40,778	2.9%	44,284	2.2%
Naphtha	30,288	31,644	4.5	34,026	2.4
Jet Fuel	3,349	3,469	3.6	3,879	3.0
Kerosene	27,606	27,925	1.2	29,571	1.7
Light Fuel Oil	31,983	34,023	6.4	38,777	3.9
Fuel Oil A	25,138	26,265	4.5	28,821	2.8
Fuel Oil B	1,357	1,091	-19.6	557	-16.3
Fuel Oil C	43,810	46,389	5.9	47,502	1.6
Electric Power	20,919	23,231	11.1	24,018	2.8
Other	22,891	23,158	1.2	23,484	0.5
LPG*	17,117	17,549	2.5	18,948	2.1
Total	202,753	211,584	4.4	227,417	2.3

*In thousands of metric tons.

Source: Ministry of International Trade and Industry

An unusually hot summer last year pushed electric utilities to their limit, another indication that energy demand is expanding faster than expected. Peak demand in several metropolitan areas, including Tokyo, nearly exceeded generation capacity; some utilities were forced to implement emergency measures, including arrangements to buy excess power from neighboring power grids and agreements by large industrial users permitting their supplies to be cut on short notice. Although both ministry analysts and utility executives do not expect this summer to be as hot, they are reassessing capital investment plans that factor in greater household demand (see JEI Report No. 18B, May 10, 1991).

In contrast, MITI can claim that years of planning put Japan in an excellent position to deal with the fallout associated with the Persian Gulf crisis. Government and private oil reserves could have compensated for

embargoed Iraqi and Kuwaiti crude for many months as Tokyo moved to release the reserves in concert with other oil-importing nations when prices for crude threatened to get out of hand. The strict monitoring of energy prices at both the wholesale and the retail level by MITI and other agencies sent a strong signal to oil companies that windfall profits would not be tolerated. MITI made it clear in discussions with refiners that the burden of higher oil prices must be borne by producers as well as consumers (see JEI Report No. 36B, September 21, 1990). Although Washington also sought to moderate price increases for gasoline and other energy supplies via moral suasion, it enjoyed less success.

MITI's handling of the energy repercussions of the Persian Gulf crisis might be considered too successful by some energy planners. In contrast to the panics that ensued after the oil shocks of the 1970s, the nation met the threat of an oil shortage with relative calm, based on assurances from government and industry spokesmen that Japan was ready for any contingency. Although prices for electricity and gasoline did rise, no actual shortages occurred nor were harsh government actions required. Since abatement of the crisis, consumers have watched energy prices begin to fall. The short duration of the crisis in combination with continued economic growth did not generate the same sense of urgency as the oil shocks of the 1970s did.

MITI Charges Up Energy Programs

The Persian Gulf experience has revitalized efforts to maintain energy policy near the top of Japan's national agenda. The likelihood that a regimen of fiscal austerity instituted by the Ministry of Finance in the early 1980s will remain in force for the coming decade, however, means that larger total outlays for energy measures are unlikely to materialize. Instead, MITI continues to cope by rearranging its budget to put money where it is needed.

According to MITI's requests for FY 1991, programs to facilitate imports of energy and help the domestic coal industry once again lost monies to programs designed to develop and introduce alternative energy sources. Coal industry support programs were cut a total of Y23.2 billion ($171.9 million at Y135=$1.00), while outlays for low-cost trade financing for energy imports and for oil industry rationalization programs were reduced. Funding for MITI's "moonlight" project, which targets energy conservation and efficiency technologies, grew from Y11.6 billion ($85.9 million) to Y11.9 billion ($88.1 million). Its counterpart "sunshine" project, which funds the development of alternative energy sources such as biomass conversion, received Y27.4 billion ($203 million). The request for renewable energy programs topped Y21.3 billion ($15.8 million). Small-scale, local alternative energy projects also enjoyed a boost to Y2.5 billion ($18.5 million) in FY 1991 to promote installation of photovoltaic and solar heating systems.

Given that petroleum will continue to play a major role in Japan's economy even if MITI fulfills its ambitious long-term plan to diversify energy sources, programs aimed at improving the efficiency of oil-using equipment remain an important part of the ministry's agenda. Funds to encourage industry to adopt more efficient equipment rose from Y31.2 billion ($231.1 million) in FY 1990 to Y34.6 billion ($256.3 million) in FY 1991. Greater attention also is being given to local projects in this field; funding for these nearly tripled to Y3.3 billion ($24.4 million) for the current fiscal year.

Nuclear power continues to be the apple of MITI's eye. According to the latest MITI outlook for electricity use and consumption, nuclear power will become the single largest source of electrical generating capacity in Japan in short order (Table 16). Because reactors must be shut down periodically for maintenance, however, atomic energy will supply only about a fifth of expected electricity consumption (Table 17). To achieve this ambitious goal the ministry is upping its nuclear power budget.

Table 16: Ten-Year Outlook for Electricity Generation Capacity by Fuel Source

(percentage of total capacity)

	FY 1990	FY 1995	FY 2000
Oil	27%	22%	17%
Liquefied Petroleum Gas	1	1	1
Liquefied Natural Gas	22	21	22
Coal	9	12	17
Nuclear	26	31	31
Hydroelectric	12	11	10
Other	3	3	3

Source: Ministry of International Trade and Industry

Table 17: Ten-Year Outlook for Electricity Consumption by Fuel Source

(percentage of total capacity)

	FY 1990	FY 1995	FY 2000
Oil	31.2%	26.7%	22.4%
Liquefied Petroleum Gas	0.6	0.5	0.6
Liquefied Natural Gas	22.1	21.4	24.2
Coal	7.1	9.9	12.5
Nuclear	18.0	20.4	21.0
Hydroelectric	20.8	20.8	18.9
Other	0.1	0.2	0.3

Source: Ministry of International Trade and Industry

Since funding is split among various categories in the general account budget and also is provided through a special energy account and other semigovernmental organizations, such as the Japan Development Bank, it is difficult to get a clear picture of the government's net spending for nuclear power. General account outlays for nuclear power, for example, showed gains for almost all line items in FY 1991, including safety measures (Y22.8 billion or $168.9 million) and spent fuel reprocessing (Y5.4 billion or $40 million). The Japan Development Bank's FY 1991 budget for nuclear energy promotion is Y210 billion ($1.6 billion), up Y10 billion ($74.1 million) from the year before. The Energy Special Account provides another Y41.4 billion ($306.7 million) for nuclear safety and reactor development plus Y539 million ($4 million) for nuclear fuel

cycle research. All this money, however, may be for naught if MITI cannot win wider public acceptance of nuclear power.

The Nuclear Option: Exercise Or Exorcise?

As the only people to suffer the effects of nuclear weapons the Japanese appear ambivalent toward nuclear power. While the horrors of Hiroshima and Nagasaki are kept fresh in their minds, the country's lack of energy resources and near-total dependence on imported fuels also is of great concern. Calling nuclear power the wave of the future, the central government has authorized the construction of nearly 40 nuclear power plants over the last 20 years.

To MITI officials the latest jewel in Japan's nuclear power crown is the newly dedicated fast-breeder reactor at Tsuruga in Fukui prefecture. Nicknamed after a kind of dome-shaped steamed bun common in Japan, the Monju project is the result of six years of entirely domestic design work; it will produce more fuel (in the form of plutonium) than it consumes. Dedicated May 18, Monju will be brought to criticality in October 1992 before coming on-line at full power in 1994; its designed output is 280,000 kilowatts. Monju is particularly controversial, however, because it will produce weapons-grade plutonium and because facilities to recover the plutonium have not yet been built. A local citizens group hopes to block the reactor's start-up in court.

While the Monju project represents a strictly domestic design, many of Japan's nuclear plants have had substantial U.S. input. The country's first advanced boiling water reactor is no exception. After a rigorous safety review MITI recently gave the green light to General Electric Co. and its Japanese partners, Hitachi, Ltd. and Toshiba Corp., to begin work on a reactor that has been in the development stage for over 10 years in cooperation with Tokyo Electric Power Co., Inc. The 1,356-megawatt unit, which will be located northwest of Tokyo, is touted as being safer as well as simpler to build and operate than previous designs. It represents GE's first significant contract for a nuclear power plant in more than 15 years.

MITI's 10-year outlook, which calls for a sharp increase in nuclear power's share of electricity generation, requires the addition of at least 40 reactors of 1-megawatt capacity or more to the current 39 operable plants. Due to public fears of nuclear power, however, only 14 have been sited or are under construction. The arguments in the debate over nuclear power have not changed since nuclear power plants began producing electricity. Safety clearly is the most important issue, but cost and environmental effects also must be addressed.

- Safety - Japanese nuclear plants, whether boiling water or pressurized water reactor types, have a record of high operating rates (Table 18). Japan compares favorably with most other industrialized nations that use nuclear power, ranking in the top three by operating rate even though it has significantly more plants than its closest competitors (Table 19). (The number of plants and the time required for maintenance and refueling are positively related.) Japan's safety record is equally exemplary. The number of reported troubles has been below one per reactor per year since 1989 despite the fact that the number of reactors in operation has grown (Table 20). Experts point to careful construction, conservative operating procedures and detailed maintenance programs as the foundation of Japan's good safety record.

Table 18: Average Operating Rate of Japanese Nuclear Power Plants

(in percentage of rated capacity; number of plants in parentheses)

Year	Boiling Water Reactors	Pressurized Water Reactors	Average*
1981	62.3%	60.0%	61.3%
	(11)	(10)	(22)
1982	70.7	69.8	70.2
	(12)	(11)	(24)
1983	67.4	72.9	70.0
	(14)	(12)	(27)
1984	73.6	70.7	72.3
	(16)	(15)	(32)
1985	74.1	74.6	74.2
	(16)	(15)	(32)
1986	72.0	81.1	76.2
	(16)	(15)	(32)
1987	79.5	79.5	79.4
	(18)	(16)	(35)
1988	72.1	68.4	70.4
	(18)	(16)	(35)
1989	71.4	73.9	72.3
	(19)	(17)	(37)
1990	68.1	75.3	71.2
	(21)	(17)	(39)

*Includes gas-cooled reactors.

Source: Ministry of International Trade and Industry

Table 19: International Comparison of Nuclear Reactor Utilization

(percentage of rated capacity; number of plants* in parentheses)

	1985	1986	1987	1988	1989	1990
Japan	74.2%	76.2%	79.4%	70.4%	72.3%	71.2%
	(32)	(32)	(35)	(35)	(37)	(39)
United States	60.1	58.3	59.6	63.5	62.0	65.9
	(87)	(92)	(99)	(106)	(108)	(110)
France	71.4	69.9	64.9	61.2	64.5	66.3
	(43)	(44)	(48)	(52)	(54)	(55)
England	54.7	52.2	47.3	52.3	52.4	50.0
	(27)	(28)	(28)	(31)	(32)	(30)
West Germany	85.8	78.3	78.8	75.3	72.3	71.0
	(16)	(17)	(18)	(20)	(21)	(21)
Canada	68.3	73.6	70.9	75.5	73.6	64.3
	(15)	(17)	(18)	(18)	(18)	(19)
Sweden	74.6	80.5	76.0	78.5	73.1	75.2
	(12)	(12)	(12)	(12)	(12)	(12)

*135 megawatts or greater.

Source: Ministry of International Trade and Industry

Table 20: Safety Record of Japanese Nuclear Reactors

	1985	1986	1987	1988	1989	1990
A. Summary Statistics						
Number of:						
Reactors	32	33	35	36	37	39
Average Annual Inspection Days	139	134	118	135	155	171
Incidents Reported by Law	19	19	19	23	22	23
Other Reported Incidents	28	30	22	25	13	12
Total Reported Incidents	47	49	41	48	35	35
Incidents per Reactor	1.3	1.4	1.2	1.3	0.9	0.9
B. Incidents Reported by Law by Reactor Type						
Reactor Type:						
Boiling Water	10	5	8	8	9	12
Pressurized Water	8	11	10	12	12	10
Gas Cooled	1	3	1	3	1	1
Total	19	19	19	23	22	23
C. Incidents Reported by Law by Classification						
Reactor Operating						
Automatic Shutdown	4	5	4	4	1	4
Manual Shutdown	8	6	7	9	10	9
Reactor Not Operating						
Damage to Steam System	6	7	5	5	9	9
Damage to Other Equipment	1	1	1	5	1	1
Other	0	0	2	0	1	0

Source: Ministry of International Trade and Industry

Two incidents in 1990, however, blemished the industry's reputation. When a tiny bit of radioactive water escaped from Kansai Electric Power Co., Ltd.'s reactor in Mihama, Fukui prefecture, operators took an unacceptable amount of time to detect and react to the situation with Japan's first-ever use of an emergency cooling system. An inspection of the reactor cooling system revealed that some supporting structures had been improperly installed. As a result, 16 other plants of similar design were combed for the same fault, and one, another KEPCO reactor at Takahama, Fukui prefecture, was closed quickly for repairs after it was found to have a similar problem. Despite the relatively minor nature of the fault, the incidents focused attention on the age

and the maintenance needs of Japan's nuclear reactors. Of the 37 still in operation, 20 were built before 1980. As Table 20 shows, the average number of days required for inspection and maintenance stood at 171 in 1990 compared to 139 in 1985. Although MITI is funding research into reactor designs that incorporate intrinsic safety features, most of the reactors now in the planning stage are of traditional design. Until MITI can offer more convincing safety arguments, fear of nuclear accidents will remain a major stumbling block in the way of new reactors.

Public concern over the safe disposal of spent nuclear fuel also is growing. Unlike the United States, Japan does not have remote unpopulated areas that can serve as waste disposal sites. Moreover, Japan is located in an area of great geological activity. Earthquakes and volcanic eruptions make land or sea burial of radioactive materials less safe. Environmentalists already are opposing construction of Japan's first reprocessing facility at Rokkasho, Aomori prefecture. MITI has yet to begin addressing these safety concerns, but if the American situation is any guide, the subject will be controversial.

• Cost - Although the phenomenon of cost overruns has not plagued the nuclear construction industry in Japan as it has in the United States, the issue of the total operating costs over the life of a reactor is becoming more important. Communities where plants are being built are demanding more concrete benefits that will continue after construction is complete. This can add significantly to a reactor's total cost. Maintenance needs, as mentioned above, are growing perhaps faster than expected, adding to the total cost. Fuel costs also are growing, although not necessarily for usable fuel. Rather, the growing costs of storing and/or reprocessing spent fuel pose a problem. Development of a domestic reprocessing capability is continuing, and the government hopes to begin building its first commercial-scale facility within 10 years. This will reduce the need to ship spent fuel overseas for reprocessing. In the meantime, storage locations for spent fuel that is not sent for reprocessing are nearing capacity, and more will have to be built. Finally, the cost of closing nuclear plants will increase as more plants reach the end of their useful lives. How all these extra costs will be distributed among the government, the utilities and their customers remains to be worked out.

• Environmental Issues - MITI touts the nuclear option as an important part of its strategy to address the "greenhouse effect," in which increased levels of carbon dioxide and other gases in the atmosphere are said to trap the sun's heat and cause global temperatures to rise. To most environmentalists, however, building more nuclear power plants to cut emissions of CO_2 is a clear case of the treatment being worse than the cure. But if not enough nuclear power plants are built, Japan may be unable to achieve its ambitious goal of stabilizing CO_2 emissions by the year 2000 (see JEI Report No. 6B, February 15, 1991). The potential environmental damage from a major reactor accident is difficult to calculate, but the example of the 1986 Chernobyl incident in the Soviet Union remains fresh in the minds of the average Japanese. The question of spent fuel disposal also enters the environmental arena because of the extremely long lifetime of the radioactive waste. An environmentally sound waste disposal method has yet to be developed, as far as most environmentalists are concerned.

It is not clear whether MITI is equipped to handle these safety, cost and environmental concerns. With its traditional bias toward the needs of industry, the ministry may not have given adequate weight to these sensitive

problems in its policy planning process. Prime Minister Toshiki Kaifu is on record that Japan will play a major role in solving global environmental issues; numerous requests in the FY 1991 budget for environment-related projects back this commitment. The growing domestic awareness about the safety and the costs of nuclear power, however, conflict with MITI's traditional goals of economic growth and industrial development. And MITI, not the Environment Agency, regulates the nuclear power industry.

New Initiatives and New Problems

Indeed, MITI is being challenged with problems and pressures well outside its traditional ken but intimately linked to energy policy. Particularly as a consequence of Japan's status as an economic superpower, energy policy is taking on the appearance of foreign policy in some cases. In nonmilitary areas especially, Japan hopes to carve out a leading global role. Some examples of these new challenges and responses include:

- Conservation - Besides trying to regulate excessive energy consumption through its spending priorities, MITI is firing up a public relations campaign to remind the average citizen that every bit of energy conserved helps. As part of its latest long-term energy outlook, the General Energy Research Council, a MITI advisory body, recalled a long string of earlier government energy-saving hints, including: adoption of clothing styles that would conserve energy (presumably by being cooler or warmer to wear); using air conditioners for only one month during the summer; turning off one-third of all interior lights; turning off all outdoor lights after 10 p.m.; closing gas stations on holidays; closing bars and night clubs at the scheduled hour; stopping television broadcasts after midnight; asking motorists not to use highways during holidays; and turning off all types of electrical appliances after every use.

Since it is highly unlikely that Japanese consumers of the 1990s would accept these restrictions except under extreme circumstances, the council suggested even greater emphasis on energy efficiency. One trend among young Japanese women, for example, is to wash their hair every day; the council has calculated that this uses energy equivalent to 735,000 kiloliters of crude oil every year. More efficient hair dryers and hot water heaters could make a dent in this amount. With air conditioners now installed in about half of all Japanese households and sales zooming, the council set a goal of saving 12.5 million kiloliters of crude oil equivalent through more efficient cooling systems.

Another move under study is to adopt daylight savings time in the summer months. Briefly used in Japan during the American occupation the system has been dormant since then. The council projected a savings of 320,000 kiloliters of crude oil equivalent a year from this change. The prospects that even these modest conservation proposals will succeed are not considered high by government planners. It is difficult to predict the technological advances necessary to improve efficiency. Moreover, some are politically sensitive, like daylight savings time. (The Labor Ministry fears it only will encourage employers to lengthen working hours, counter to the ministry's goal.)

- International Energy Agency - The IEA, formed in 1974 by 21 industrialized oil-consuming nations in response to the establishment of the Organization of Petroleum Exporting Countries, has become a center of activity since the Persian Gulf crisis began. Tokyo has assumed a more prominent role in urging IEA members to take further steps to cushion future oil crises, even going

so far as to support talks between the agency and OPEC (a step opposed by the United States and Great Britain). Tokyo, this time along with the United States, also successfully lobbied to have the IEA-proposed European Energy Charter opened to all interested nations. The charter seeks to formalize the exchange of Soviet oil and gas for economic assistance. Tokyo also is pushing the IEA to adopt guidelines encouraging nuclear power and curbing CO_2 emissions.

• Nuclear Proliferation - Although not often classified as a safety issue, Iraq's nascent nuclear weapons capability, much discussed after Baghdad invaded Kuwait, reminded every Japanese of the dual uses of nuclear power. Because of its experience in World War II, Japan sees itself as well qualified to preach the dangers of nuclear proliferation. In recent months Japanese officials have been more forward in using Japan's economic power to try to stem nuclear proliferation. Tokyo, for example, currently is negotiating improved ties with Pyongyang. North Korea would like to have access to the giant Japanese market, to Japanese capital and to Japanese technology. Before advancing with talks, however, Tokyo insisted that Pyongyang agree to allow inspections of its nuclear facilities by officials of the International Atomic Energy Agency. North Korean representatives initially blasted Japan's stance with harsh rhetoric. But Tokyo stood firmly in line with the United States and South Korea in demanding unconditional inspections. Pyongyang announced in mid-June that it would yield to the demand but then hedged its commitment, linking it to a withdrawal of U.S. nuclear weapons from South Korea. Similarly, Tokyo soon will ink a nuclear safety and technology cooperation pact with China; again, it is insisting on safeguards against the technology being used for military purposes.

• Cooperative Nuclear Research - Cooperation between Japan and the United States in the area of nuclear power certainly is not a new development. Joint projects on reactor design and fuel reprocessing are numerous and long-standing. The International Tokamak Experimental Reactor, however, is a significantly different test of Japan's commitment to cooperative research. The United States and the Soviet Union proposed the ITER idea in 1985. Japan and the European Community signed on soon after this, and joint research commenced in 1988. The conceptual design has been completed, and the partners now are preparing to invest $750 million over the next several years on a detailed engineering plan. Washington, Tokyo and Brussels are deadlocked, however, each demanding that this engineering take place within its own borders. The apparent reasoning is that construction of the reactor will take place close to where the design is developed. The Soviet Union's opinion clearly will be an important factor in resolving this issue. Although it is possible to split the design team among several locations, everyone agrees that this would be inefficient.

Conclusion

Japanese energy policy appears to be entering middle age. The earlier drive for conservation and increased efficiency has yielded such positive results that energy policy no longer tops the national agenda. The Persian Gulf crisis was not enough to resurrect energy as a primary concern, but it was sufficient to revitalize MITI's attention to energy policy. Further gains in energy efficiency, however, will be difficult to come by for two reasons. First, Japanese industry already has made major strides, making improvement harder to achieve. Second, the country's new preoccupation with raising the standard of living translates into greater, not less, demand for energy; that is not hospitable to conservation efforts. In other areas, however, Japan's energy policy

NOTE

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